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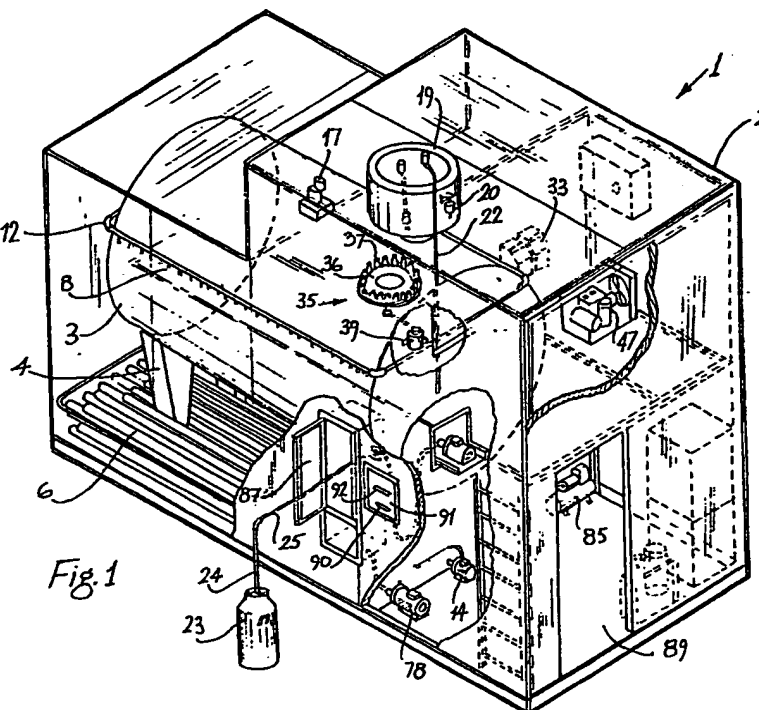
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## (54) Liquid storage apparatus

(57) The invention provides apparatus for collecting a plurality of batches of milk and storing them for subsequent collection.

Essentially, the apparatus comprises a housing (2) within which is mounted a main storage tank (3), and a receiving tank (19) to receive each batch. The batch is weighed in the tank (19) and the temperature, pH and conductivity is also monitored. A sample is also collected in a sample bottle (37) for subsequent analysis. If the batch is acceptable, it is then delivered from the receiving tank (19) into the main storage tank (3). If it is unacceptable, it is rejected to waste.

Washing apparatus to wash the receiving tank, the main storage tank and the milk pipelines is also provided. Security doors (87 and 89) are provided to permit access to the apparatus to authorised people only.



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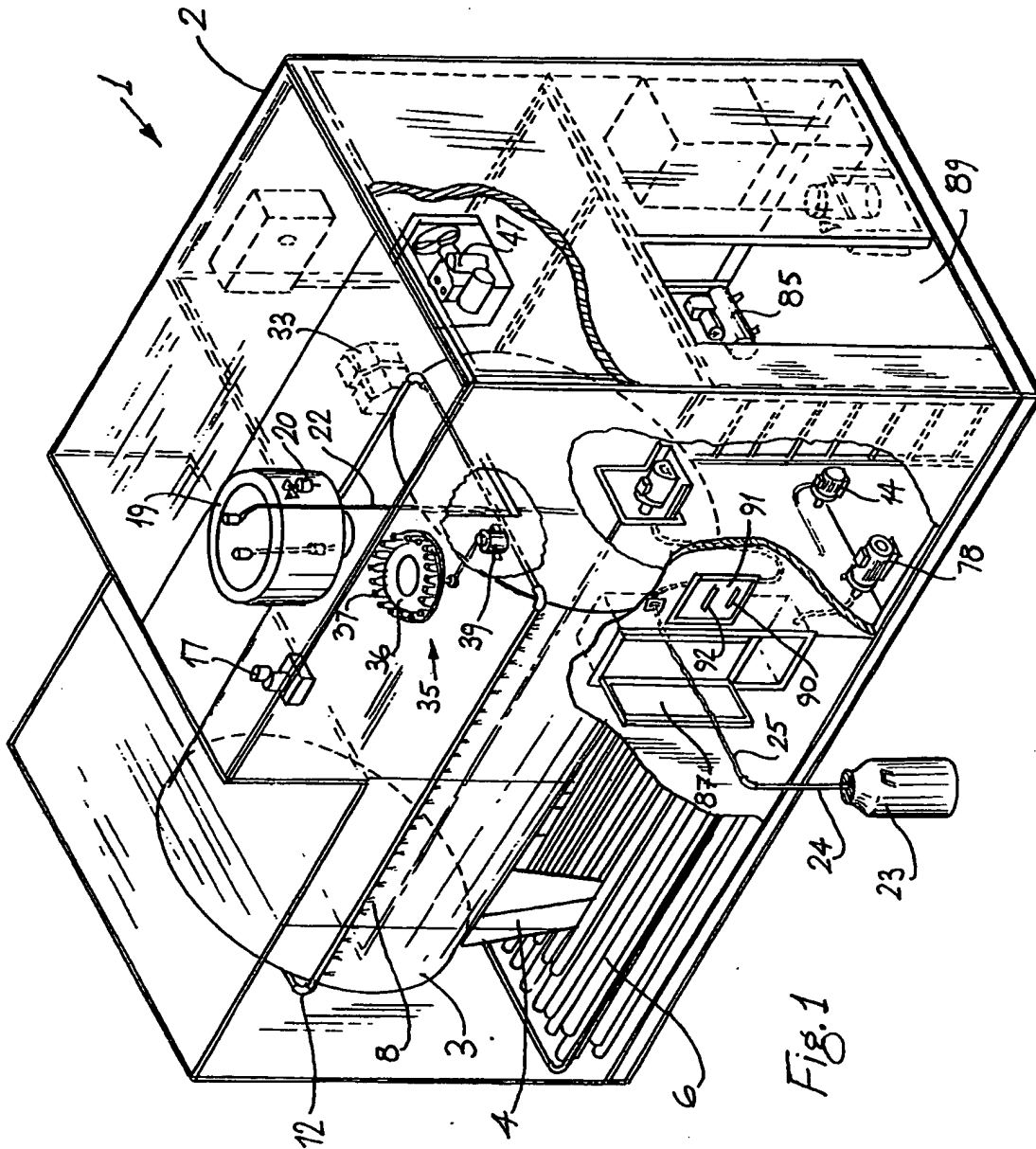
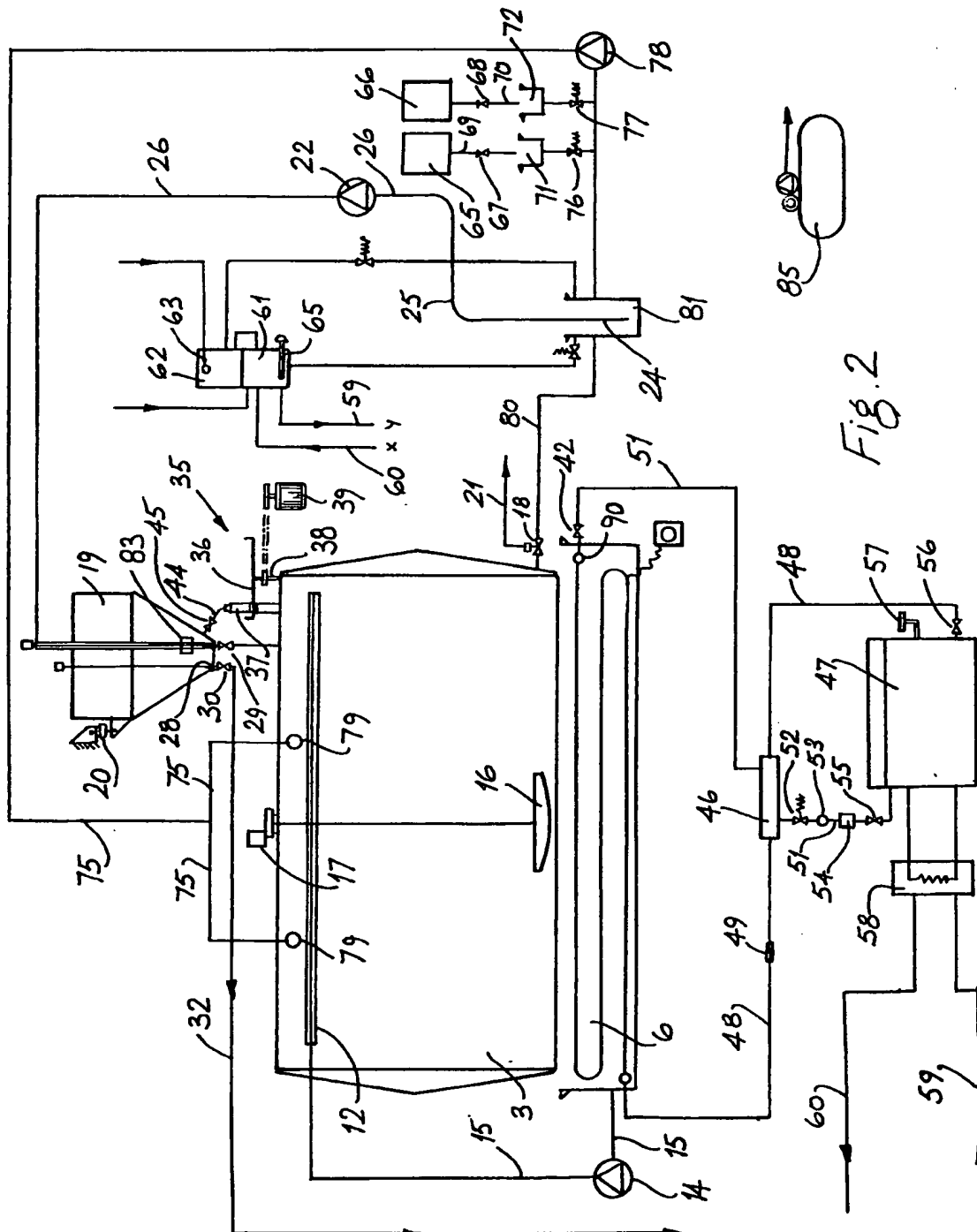


Fig. 1



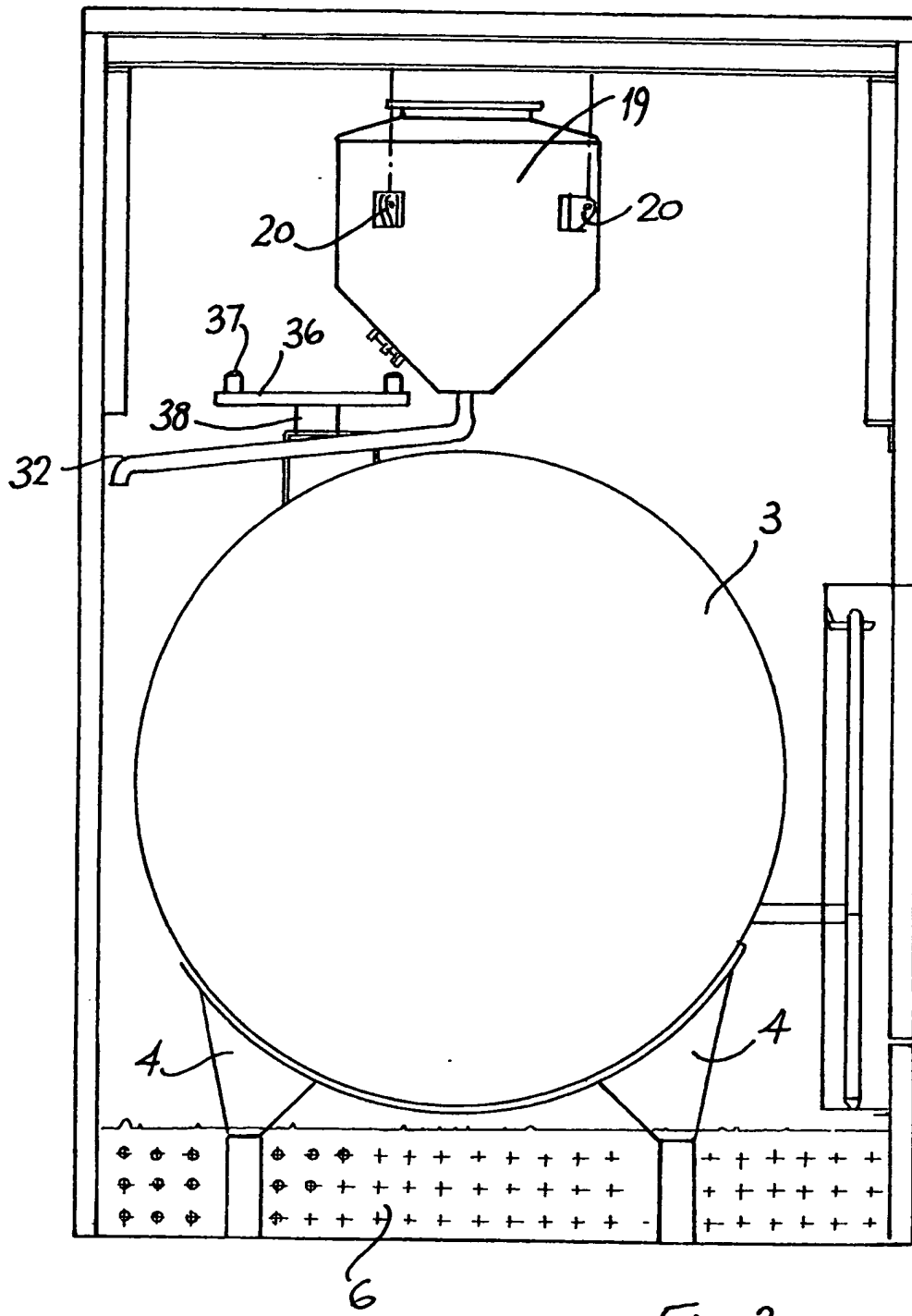
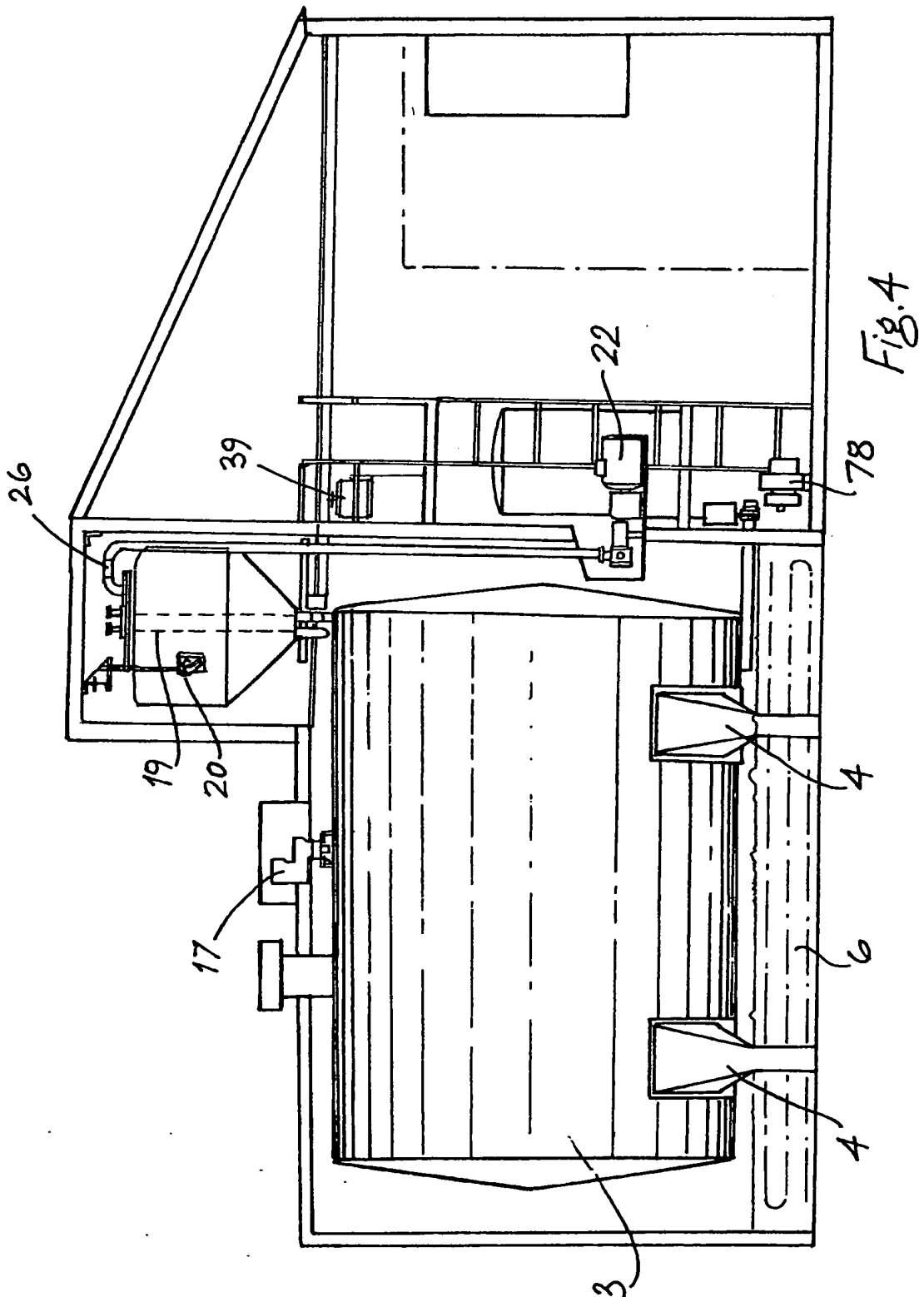


Fig.3



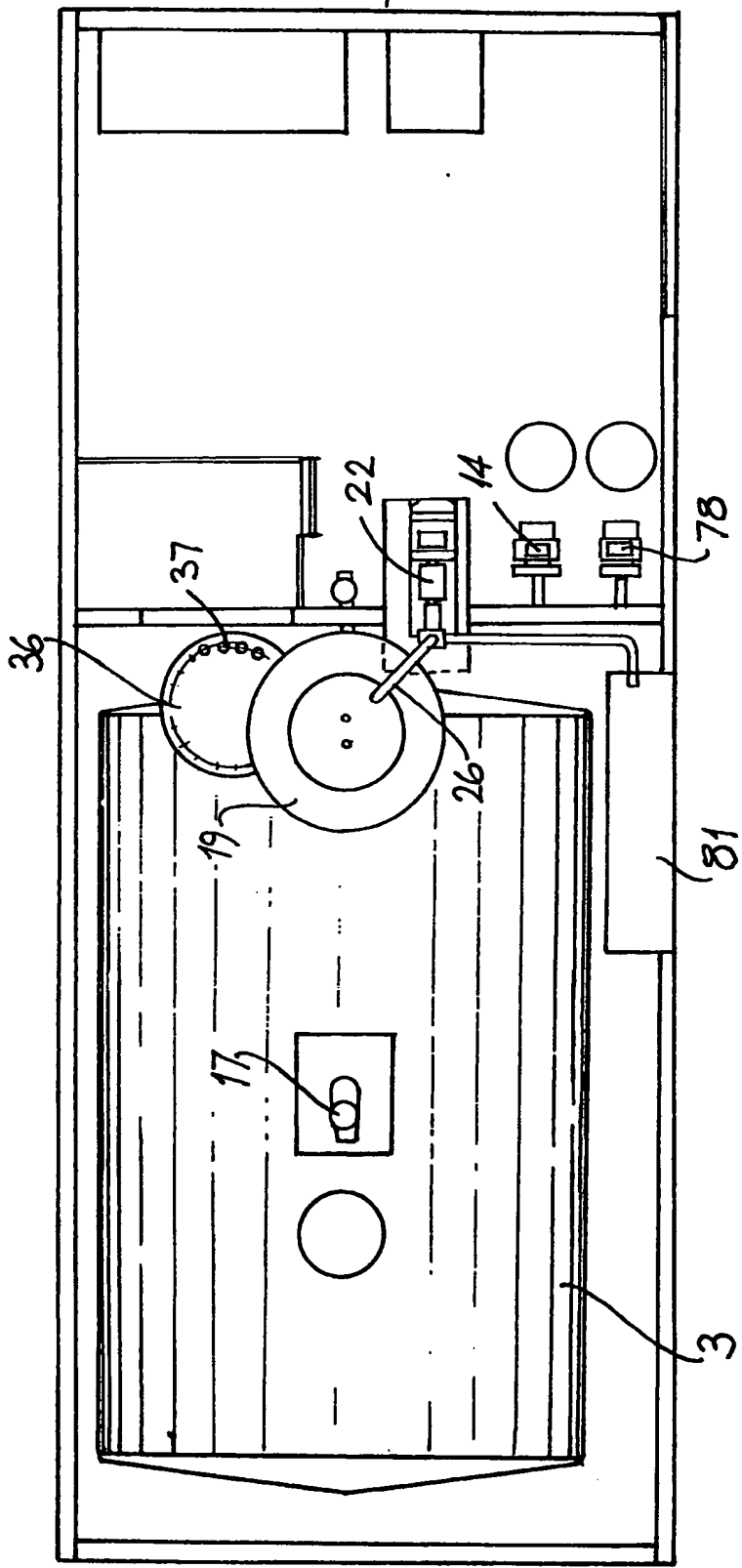


Fig.5

## SPECIFICATION

## Liquid storage apparatus

5 The present invention relates to a method and apparatus for storing liquid, and in particular, for storing bulk milk, although, needless to say, it is not limited to the storage of bulk milk.

According to the invention, there is provided liquid storage apparatus comprising a main liquid storage tank, a liquid receiving tank for receiving discrete batches of liquid, a weighing means on the receiving tank for weighing each batch, and means to transfer the liquid from the receiving tank to the main storage tank.

Preferably, the weighing means is provided by load cells on which the receiving tank is mounted.

Advantageously, the receiving tank is mounted above the main storage tank and the transfer means for transferring the liquid from the receiving tank to the main storage tank is provided by a pipe extending between the receiving tank and the main storage tank, a valve being provided in the pipe, and control means being provided to control the valve.

In one embodiment of the invention, means to measure certain parameters of each batch of liquid is provided in the receiving tank.

In another embodiment of the invention, the PH, temperature and conductivity of each batch is measured.

Preferably, means to deliver a reject batch of liquids to waste from the receiving tank, is provided.

In a further embodiment of the invention, sampling means is provided to receive a sample of liquid from each batch and to discreetly store the sample for further analysis.

In a still further embodiment of the invention, chiller means is provided to chill the liquid in the main storage tank.

Advantageously, washing means are provided to wash the main storage tank and the receiving tank.

Additionally, the invention also provides a method for storing batches of liquid using the apparatus, comprising the step of delivering a batch of liquid to the liquid receiving tank, weighing the batch in the liquid receiving tank, measuring certain parameters of the batch of liquid in the liquid receiving tank, comparing the measured parameters with predetermined values, and delivering the batch to the main storage tank.

Preferably, the method also includes the step of delivering a rejected batch to waste.

In another embodiment of the invention, the method includes the step of washing apparatus after the stored liquid has been collected.

In another embodiment of the invention, the method and apparatus is for storing milk.

The invention will be more clearly understood from the following description of a preferred embodiment thereof, given by way of example only, with reference to the accompanying drawings, in which:

Fig. 1 is a perspective view of apparatus according to the invention;

Fig. 2 is a schematic representation of the apparatus of Fig. 1;

Fig. 3 is an end view of the apparatus of Fig. 1;

Fig. 4 is a side view of the apparatus of Fig. 1;

and

Fig. 5 is a plan view of the apparatus of Fig. 1.

Referring to the drawings, there is provided liquid storage apparatus according to the invention, indicated generally by the reference numeral 1. In this case, the apparatus is specifically provided for storing batches of milk for subsequent collection by, for example, a creamery tanker. It is envisaged that the apparatus will be used by many relatively small farmers, each of which would bring their own batch to the apparatus where it would be stored for subsequent collection.

The apparatus 1 comprises a housing 2, which houses all the components of the apparatus. A 10,000 litre main milk storage tank 3 is mounted in the housing 2 on supports 4, which stand in a chilling means, in this case a bank of ice 6 which is envisaged will store a minimum of 700 kg of ice. Refrigeration means, which will be described below, produces the ice. A plurality of jets 8 on a pipeline 12, spray chilled water onto the storage tank 3 to retain the milk in the storage tank under 4°C. A pump 14, see Fig. 2, pumps chilled water from the ice bank 6 through a pipeline 15 to the jets 8. An agitator 16 immersed in the main storage tank 3 is driven by an electric motor 17 to gently agitate the milk in the storage tank 3. An outlet 13 from the main storage tank 3 is connected through an air operated valve 18 into a pipeline 80 into a sump 81, which will be described below. A coupling device (not shown) is provided at the end of the pipe 80 in the sump 81 for connection to a mobile road tanker for subsequent collection of the milk in the storage tank 3.

A receiving tank 19 to receive a sample each batch prior to it being delivered into the main storage tank 3, is mounted above the main storage tank 3 onto the framework (not shown) of the housing 2 by means of load cells 20. A pump 22 pumps the milk of each batch, for example, from a milk churn 23 from an inlet pipe 24, which is immersed in the churn 23, to the receiving tank 19. The inlet pipe 24 is connected by a flexible hose 25 through a pipeline 26 to the pump 22, and then into the receiving tank 19. A pair of outlets 27 and 28 are provided in the bottom of the receiving tank 19. The outlet 27 is connected through a valve 29 and a pipe 30 to the main storage tank 3 for delivering the milk from the receiving tank 19 to the main storage tank 3. The outlet 28 delivers rejected milk from the receiving tank 19 through a valve 31 and a pipeline 32 to waste. Both valves 29 and 31 are controlled by a microcomputer 33 which will be briefly described below.

Means to measure the temperature, PH and conductivity of the milk in the receiving tank are provided in the receiving tank. These means are not illustrated, as they will be readily known to those skilled in the art. The measuring means are connected into the microcomputer, and the monitored values are compared with predetermined values.

Once the batch of milk compares favourably the valve 29 is opened and the milk is delivered to the main storage tank 3. If the monitored data do not compare favourably, then the milk is rejected through the waste pipe 32.

A sampling means to withdraw a sample from each batch and discreetly store it for subsequent analysis, in this case is provided by sampling apparatus 35. The sampling apparatus 35 comprises a rotatable tray 36 around the periphery of which are stored twenty-six sampling bottles 37. The tray 36 is mounted on a shaft 38 which is rotatable in a mounting arrangement (not shown) on the top of the main storage tank 3. An electric motor 39 through pulleys 40 and belt 41, drives the tray 26 through the shaft 38. An outlet pipe 44 from the receiving tank 19 delivers the sample to a bottle 37. A valve 45 in the outlet pipe 44 controls the size of the sample dispatched. The motor 39 moves the tray 36 in incremental steps to align the desired sample bottles 37 with the outlet 44 for taking the sample, this is described below.

The volume of ice on the ice bank 6 is controlled by an ice stat (not shown) which measures the thickness of ice build up. The ice bank 6 is connected to a condensing heat exchanger 47 through pipelines 48 and 51. The condensed gas is held in a receiver (not shown) and on demand from the ice bank 6, a solenoid valve 42 opens and passes the condensed gas through an expansion valve 90 thereby dropping the temperature of the ice as the liquid gasses off. An inline heat exchanger 46 is installed to avoid the possibility of liquid returning to the compressor (not shown) of the heat exchanger 47 by slight heat exchange to bring the suction gas above dew point. A temperature bulb 49 is provided in the line 48. A solenoid valve 5, a sight glass 53, a drier 54, a gate valve 55 are provided in the line 51 between the heat exchangers 46 and 47. A second gate valve 56 is provided in the line 48 between the heat exchangers 46 and 47. The solenoid valve 52 is controlled by the microcomputer. A high pressure/low pressure switch 57 is provided in the heat exchanger 47. When the ice stat is covered by ice the solenoid valve 42 is closed and the compressor continues to pump until the suction pressure reduces to the low pressure switch 57 which stops the compressor. The high pressure switch is provided for safety. The hot discharge from the compressor (not shown) of the heat exchanger 47 is fed through a heat exchanger 58 to heat water in the lines 59 and 60 for heating water in a hot water tank 61 to preheat wash water for washing purposes. The preheating of the water in the tank 61 is supplemented by an electric heating element 65 in the tank 61. The computer controls the heater 65 and switches it on some hours before the cleaning cycle is due to commence.

Washing apparatus is provided for washing out the receiving tank 19 and storage tank 3, and the milk lines of the apparatus. The washing apparatus comprises a cold water header tank 62 which receives cold water through a ball cock valve 63 from a source (not shown). This feeds the hot water tank 61 and an electrical immersion heating element 64

is provided in the hot water tank 61. Two storage tanks 65 and 66 store Nitric acid and caustic soda respectively. Valves 67 and 68 in outlet pipes 69 and 70, respectively deliver measured quantities of the acid and caustic soda into containers 71 and 72 respectively for washing purposes. The valves 67 and 68 are controlled by the microcomputer. The measured quantities in the containers 71 and 72 are then dispensed into a washing circuit 75 as required, through valves 76 and 77, which are also controlled by the microcomputer. A circulating pump 78 in the washing circuit 75, delivers the washing and rinsing fluid through the circuit 75 into the main storage tank 3 through spray balls 79. The washing fluid is returned from the main storage tank 3 through the three way valve 18 and a pipeline 80 into a sump 81, from which it is drawn back into the washing circuit 75 by the pump 78. During the washing cycle, the inlet pipe 24 is also immersed in the sump 81, and the pump 22 circulates the washing fluid from the sump 81 into the receiving tank 19 through a spray valve 83. This washing fluid is returned into the main storage tank 3 through the line 30. A compressor 85 is provided in the housing 2 for powering the various air operated valves.

Access to the housing is provided through a hand door 87 and a main door 89. Only a person authorised by the creamery will have access to the housing through the main door 89. Those delivering batches of milk to the container will have access only through the hand door 87. This access is gained by inserting an identity card into a slot 90 in an inspection apparatus 91. The inspection apparatus 91 is controlled by the microcomputer. Once the computer is satisfied that the person presenting the card is a bona fide user, the hand door 87 is unlocked. The person can then withdraw the inlet pipe 24 and commence operation. On return, the inlet pipe is replaced in the sump 81, which as can be seen in Fig. 1, is provided beneath the hand door 87. The main door 89 provides access to all the apparatus, and the person authorised by the creamery when collecting the milk will collect all records from the microcomputer as well as the sample bottles 37, and will activate the washing cycle.

A digital display 92 in the apparatus 91 displays the weight and temperature of the batch.

In use, each farmer on presenting his card in the slot 90, gains access to the apparatus through the hand door 87. He then removes the inlet pipe 24 and inserts it in the milk churn 23 or other container. He activates the pump 22 by a switch (not shown) inside the hand door 87 to pump the milk into the receiving tank 19. When the batch has been pumped into the receiving tank 19, the farmer deactivates the pump 22 and replaces the inlet pipe 24 in the sump 81. The monitoring and sampling of the batch in the receiving tank 19 commences. The results of the monitoring are displayed for the farmer on the visual display 92. If the batch of milk is acceptable, the computer then activates the valve 29 and the batch is discharged into the main storage container.

In the event of a batch failing to comply with the predetermined parameters, then the microcomputer opens the valve 31, and the batch is discharged to waste.

- 5 In carrying out sampling, the motor 39 moves rotates the tray 36 to a desired position designated by the card coding. This position is confirmed by electrical means (not shown) to ensure the appropriate sample bottle aligns with the outlet 44. Prior  
10 to each sample being taken, the outlet 44 is cleaned by opening the sample valve 45 and flushing through with milk. This is done when the rotating table is in position 1, and this permits the flushed milk to drain into the main storage tank. By  
15 virtue of the fact that the sampling apparatus permits a particular sampling bottle to be aligned for each sample, a number of samples may be collected over, for example, a fourteen day period for each farmer's milk or, for example, butter fat determination, or alternatively if desired, a single hygienic sample for quality purposes may be taken.

- When it is desired to pump the stored milk from the main storage tank 3 into a mobile tanker, the creamery operative gains access to the apparatus  
25 through the door 87 by inserting his identity card into the slot 90. The flexible pipe of the tanker is connected to the pipe 80 by a coupling device (not shown) in the sump 81. The valve 18 is opened to connect the storage tank 3 to the tanker (not  
30 shown) through the pipe 80 and the contents of the storage tank 3 are then pumped into the tanker by the tanker's pumps. When the tank 3 is empty the flexible pipe of the tanker is disconnected and the door 87 closed. The valve 18 remains open for  
35 washing purposes. The creamery operative then activates the cleaning cycle, and the receiving tank 19, the main storage tank 3 and the pipelines are thus washed.

- The cleaning cycle comprises the following  
40 steps. Initially, the entire system is rinsed with hot water, a second hot prerinse, also of hot water, is then applied. The valves 67 and 75 are then opened and the system is washed with a mixture of hot water and caustic soda. The valves 68 and  
45 77 are similarly opened and an acid rinse is carried out, also with hot water. Between each wash and each rinse the system is drained. Two cold rinses are applied to the entire system. After each rinse the system is drained. The apparatus is then ready  
50 to receive the next batch of milk.

- The operative then collects all relevant data from the microcomputer in relation to the milk, and also collects the samples in the sample bottles 37. Needless to say, it will be appreciated that at any  
55 time during the course of collection and washing, the creamery operative, by virtue of information on his identity card, may gain access to the apparatus through the door 89.

- It will be appreciated that while the apparatus  
60 has been described as having the receiving tank above the main storage tank, this is not necessary. In many cases, it is envisaged that the receiving tank may be below the main storage tank, in which case each batch of milk will be pumped from the  
65 receiving tank to the main storage tank. Similarly,

it will be appreciated that if it were a thing that the receiving tank was at a sufficiently low level, then each batch could be delivered directly into the receiving tank without the need for pumping.

- 70 It will also be appreciated that while the main storage tank has been described as being refrigerated, this is not necessary in all cases.

- Additionally, it will be appreciated that many other means for transferring the milk into the receiving tank may be provided besides a pump  
75 means.

- It will also be appreciated that in certain cases other refrigeration arrangements may be used, and similarly, it will be appreciated that while the apparatus has been described as being controlled by a  
80 microcomputer, this is not necessary, any other suitable controlling means could be used.

- It will also be appreciated that in certain cases the compressor may be dispensed with. Additionally, it is envisaged that while the apparatus has  
85 been described for storing milk, it could be used for storing any other liquids.

- It will also be appreciated in certain cases other parameters of the liquid besides those monitored, may be monitored. In fact, more or less parameters as desired, may be monitored. Similarly, in  
90 certain cases it is envisaged that the sampling apparatus may be dispensed with, and in other cases it is envisaged that different sampling apparatus  
95 may be provided.

- It will of course be appreciated that while agitating means have been described as being provided in the main storage tank, this is not necessary and may be dispensed with in certain embodiments of  
100 the invention.

- It is also envisaged that in certain cases the microcomputer may have an interface to permit the creamery operative to interface a mobile computer into the microcomputer, thereby transferring the relevant data regarding each batch into the mobile  
105 computer for subsequent analysis of the creamery. It is also envisaged that the microcomputer will have a facility to interface with a telephone link back to the creamery.

- While a particular weighing means has been described for weighing each batch in the receiving tank, any other suitable weighing means could be provided. Additionally, other suitable washing and  
110 rinsing apparatus may be used. In fact, in certain cases it is envisaged that the washing apparatus may be dispensed with altogether.

- Additionally, it will be appreciated that while the apparatus has been described as mounted in a particular type of housing, it could be mounted in  
120 any other suitable location.

- It will also be appreciated that where the quantity of milk to be delivered into the apparatus exceeds the capacity of the receiving tank, then once the receiving tank has reached its capacity, it will  
125 operate as already described, and the remainder of the batch will then be received separately. Further, it will be appreciated that while specific sizes of tanks and capacity of refrigeration has been described, any other suitable sizes and capacities  
130 could be used.

It is also envisaged that while the sampling apparatus has been described as holding twenty-six sample bottles, any number of sample bottles more or less than twenty-six could be provided.

5 Needless to say, other suitable means for sampling could be provided.

It will also be appreciated that while nitric acid and caustic soda have been described for washing and rinsing purposes, any other suitable acids, detergents or the like could be used.

#### CLAIMS

1. Liquid storage apparatus comprising a main liquid storage tank, a liquid receiving tank for receiving discrete batches of liquid, a weighing means on the receiving tank for weighing each batch, and means to transfer the liquid from the receiving tank to the main storage tank.

20 2. Liquid storage apparatus as claimed in claim 1, in which the weighing means is provided by load cells on which the receiving tank is mounted.

3. Liquid storage apparatus as claimed in claim 1 or 2, in which the receiving tank is mounted above the main storage tank and the transfer means for transferring the liquid from the receiving tank to the main storage tank is provided by a pipe extending between the receiving tank and the main storage tank, a valve being provided in the pipe, and control means being provided to control the valve.

4. Liquid storage apparatus as claimed in any preceding claim, in which means to measure certain parameters of each batch of liquid is provided in the receiving tank.

5. Liquid storage apparatus as claimed in claim 4, in which the measuring means measures the PH of each batch of liquid in the receiving tank.

6. Liquid storage apparatus as claimed in claim 4 or 5, in which the measuring means measures the temperature of each batch of liquid in the receiving tank.

7. Liquid storage apparatus as claimed in any of claims 4 to 6, in which the measuring means measures the conductivity of each batch in the receiving tank.

8. Liquid storage apparatus as claimed in any of claims 4 to 7, in which a visual display means is provided to display the monitored parameters of the fluid.

9. Liquid storage apparatus as claimed in any preceding claim, in which means to deliver a reject batch of liquids to waste from the receiving tank, is provided.

10. Liquid storage apparatus as claimed in claim 9, in which the delivery means is provided by a waste outlet pipe from the receiving tank, and a valve is provided in the outlet pipe, control means being provided to control the valve.

11. Liquid storage apparatus as claimed in any preceding claim, in which the sampling means is provided to receive a sample of liquid from each batch and to discreetly store the sample for further analysis.

12. Liquid storage apparatus as claimed in

claim 11, in which the sampling means comprises means for directing each sample into a separate sample bottle.

13. Liquid storage apparatus as claimed in claim 12, in which the sampling means comprises a rotatable tray for holding a plurality of bottles on a substantially circular path, and means to rotate the tray, so that for each sample, a fresh sample bottle is presented beneath an outlet from the sample outlet.

14. Liquid storage apparatus as claimed in claim 13, in which the rotatable tray is mounted beneath the receiving tank and the sample outlet extends from the receiving tank.

15. Liquid storage apparatus as claimed in any preceding claim, in which chiller means is provided to chill the liquid in the main storage tank.

16. Liquid storage apparatus as claimed in claim 15, in which the chiller means comprises a bank of ice and means for circulating chilled water over the main storage tank.

17. Liquid storage apparatus as claimed in claim 16, in which the bank of ice is mounted beneath the main storage tank, and spray jets are provided above and/or at the side of the storage tank for spraying the chilled water over the main storage tank.

18. Liquid storage apparatus as claimed in any preceding claim, in which washing means are provided to wash the main storage tank and the receiving tank.

19. Liquid storage apparatus as claimed in claim 18, in which the washing means comprises a hot water source.

20. Liquid storage apparatus as claimed in claims 18 or 19, in which the washing means comprises a cold water source.

21. Liquid storage apparatus as claimed in any of claims 18 to 20, in which means to store a cleansing solution is provided.

22. Liquid storage apparatus as claimed in claim 21, in which the storage means comprises caustic soda.

23. Liquid storage apparatus as claimed in claims 21 or 22, in which the storage means stores a scouring acid.

24. Liquid storage apparatus as claimed in any of claims 18 to 23, in which circulating means is provided to circulate the water and cleansing solutions through the apparatus.

25. Liquid storage apparatus as claimed in any of claims 18 to 24, in which spray jets for delivering the washing water and solution into the receiver tank and main storage tank, are provided.

26. Liquid storage apparatus as claimed in any preceding claim, in which an outlet from the main storage tank is provided for delivering the liquid from the main storage tank.

27. Liquid storage apparatus as claimed in any preceding claim, in which an inlet pipe is provided for receiving the liquid, the inlet pipe being connected through a pump for pumping the liquid from the inlet pipe to the receiving tank.

28. Liquid storage apparatus as claimed in claim 26, in which the inlet pipe is flexibly con-

nected to the pump, so that the inlet pipe may be immersed in a container adjacent the apparatus.

29. Liquid storage apparatus as claimed in any preceding claim, in which a microcomputer is provided to control the apparatus and to control the various control means.

30. Liquid storage apparatus as claimed in claim 29, in which the microcomputer also monitors and compares the various parameters of the liquid.

31. Liquid storage apparatus as claimed in any preceding claim, in which the apparatus is housed in a housing, and access means are provided in the housing to the liquid receiving pipe.

32. Liquid storage apparatus as claimed in claim 31, in which access to the housing is provided by a personal identification card.

33. Liquid storage apparatus as claimed in any preceding claim, in which agitating means are provided in the main storage tank.

34. Liquid storage apparatus as claimed in any preceding claim, in which the apparatus is for storing milk.

35. Liquid storage apparatus substantially as described herein, with reference to and as illustrated in the accompanying drawings.

36. A method for storing batches of liquid using the apparatus of claims 1 to 35, the method comprising the step of delivering a batch of liquid to the liquid receiving tank, weighing the batch in the liquid receiving tank, measuring certain parameters of the batch of liquid in the liquid receiving tank, comparing the measured parameters with predetermined values, and delivering the batch to the main storage tank.

37. A method as claimed in claim 36, in which the method also includes the step of delivering a rejected batch to waste.

38. A method as claimed in claim 36 or 37, in which the PH of the liquid is measured.

39. A method as claimed in any of claims 36 to 38, in which the temperature of the liquid is measured.

40. A method as claimed in any of claims 36 to 39, in which the conductivity of the liquid is measured.

41. A method as claimed in any of claims 36 to 40, in which a sample is taken from the batch of liquid in the liquid receiving tank.

42. A method as claimed in any of claims 36 to 41, in which the method includes the step of pumping a batch of liquid to the receiving tank.

43. A method as claimed in any of claims 33 to 42, in which the method also includes the step of pumping the liquid from the main storage tank to another tank, for example, a mobile tanker.

44. A method as claimed in any of claims 36 to 43, in which the method also comprises the step of washing the apparatus.

45. A method as claimed in claim 44, in which the step of washing the apparatus comprises the following steps:

rinsing the receiving tank and main storage tank with a hot rinse,

rinsing both tanks with a hot pre-rinse,

washing both tanks with hot caustic wash, cold rinsing each tank, and second cold rinsing the tank.

46. A method for storing batches of liquid substantially as described herein, with reference to the accompanying drawings.

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